01

ELECTRICAL DESIGN ANALYSIS

TRANSMITTER FACILITY

STATINTL

[redacted]

60 % REVIEW PRINT

JAN. 22.1968

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Project Transmitte [redacted] of 17
Feature Electrical Design Analysis Designed M.I. Date 18 Jan 1968
Item Design Analysis Summary Checked Date

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I. GENERAL: The electrical design for Transmitter Facility [redacted] covers Transmitter Building and Gate House including the installation of government furnished 200 KW diesel engine driven generator sets with switchgear; interior work including power, lighting, control, grounding system, fire alarm, and outlets, conduit, terminal cabinet, cable tray and floor trench system for telephone, intercommunication and technical equipment wiring by others; and exterior work including extension to existing primary power distribution, protective lighting, secondary power service to Gate House and provisions of duct sleeves under roads and paved area for antenna cables by others.

II. DESIGN CRITERIA:

a. Request for Proposal on Design, POOGM letter of 15 March 1966 with the following attachments:

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1. Using Agency Sketch Drawings:

No drawing number	[redacted]
Dwg. No. D5345-T/D-01,	Interior Grounding
Dwg. No. D5020-T/D-01,	Exterior Grounding
Dwg. No. D5341.02-T/F-01,	Floor Plan
Dwg. No. D5345-T/CL-01,	Plot Plan, Transmitter Site
Dwg. No. D5345-T/E-01,	Bus Duct & Power Panel Locations
No drawing number	Government Furnished Electrical Equipment

2. Scope of Work.

3. POD Comments on the Scope of Work, dated March 1966.

4. Description and Analysis of Electrical System (System 5).

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b. Scope of Work attached to and made a part of Contract No. [redacted]

c. Using Agency Information, Ref: POOGM letter of 9 April 1966 with the followings:

1. T.M.C. Power Distribution, Inc. drawings for 200 KW engine generator set,

Dwg. No. 15554-C,	Radiator Shroud & Guard
Dwg. No. 15342-C,	Lockout for Shockmounts
Dwg. No. 15587-B,	Mounting Detail
Dwg. No. 15549-B,	Battery Charger Wiring Diagram
Dwg. No. 155751-B,	Battery Charger 2412-52
Dwg. No. 15426-C,	Standard Engine Wiring Harness
Dwg. No. 15520-D,	Schematic
Dwg. No. 15770-D,	Assembly Drawing
Dwg. No. 15416-D,	Assembly Drawing
Dwg. No. 15589-D,	Storage Battery (Ordnance)
Dwg. No. 17016-D,	Wiring Diagram
Dwg. No. 15755-D,	Cabinet & Door Layout
No drawing No.	Point to Point Wiring Diagram

2. Installation and Maintenance Manual, Granger Associates Model 747L antenna.

3. Using Agency Sketch Drawings, same drawings listed in design criteria reference a.1. plus the followings;

Dwg. No. D5345-T/S-01,	Heat Load
Dwg. No. D5345-T/S-02,	Antenna Cable Tray System
Dwg. No. D5345-T/S-03,	Transmitter/Exciter Cable Tray System
Dwg. No. D5345-T/S-04,	Signal Cable Tray System

STATINTL d. Additional Information, Ref: POOGM letter of 18 June 1966 with the following [redacted] drawings.

Dwg. No. D-208316, System No. 5 SWBD Arrangement

Dwg. No. C-208290, Load Box Arrangement

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e. [redacted] Review Comments for 30% completion of the design.

f. Info for Facility Site change, Ref: POOGM letter of 29 November 1967.

g. Instruction Book for Rotatable Unidirectional HF Antenna 237B-3 with 2 prints for 437C-3A Antenna.

STATINTL h. Data for Broad Band Dipole Antenna 437G-2A, Ref: POOGM letter of 1 December 1967.

STATINTL i. As-Built Dwgs. for [redacted]), reference for existing primary power line, Ref: POOGM letter of 15 December 1967.

STATINTL j. Memorandum for the Record of the meeting held on 11 January 1967 with [redacted] Ref: Our letter of 16 January (Ref. No. C-16-68).

k. Department of the Army Technical Manuals, TM5-811-1 and -2.

STATINTL l. Applicable [redacted]

m. NEC 1965.

n. IES Lighting Hand Book, 4th edition.

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III. DESIGN RESUME:

Generally, five basic design pointers were considered in the electrical system layout such as safety capacity, flexibility, accessibility and reliability.

Circuit design will conform to the requirements of the National Electrical Code.

Circuit loading is generally 20-ampere, 2-wire, 120-volt for lighting and receptacles.

In all cases, loading of circuit will not exceed 80% of the branch circuit rating.

Branch circuits and feeders overcurrent protection will be rated 25% greater than the load rating, but shall not exceed 150% of the load.

Specific rules for fuse and circuit breaker setting and coordination of the National Electrical Code will be followed.

Basic limitations on voltage drop for this design will be:

3% for feeders or sub-feeders from transformer to lighting or power panelboards.

2% for branch circuits to lighting or power loads.

Motor circuits will be 2 & 3% of the above respectively.

The number of lighting and power branch circuits will be based on the final load requirements of the building.

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Electric power will be derived from plug-in bus duct at 240 volts, 3-phase generators are GFM and will be wired for complete integration with [redacted]

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Building utility load power will be 120/208 volts derived from a 150 KVA dry type transformer except for air conditioning equipment.

Grounding is a stringent requirement of this project. Design is prepared in accordance with the using service grounding requirements and the National Electrical Code.

There will be two separate grounding systems though it is realized that a single grounding source is generally always used for grounding both the system and equipment.

The building system neutral will be grounded at the power entrance cubicle located in the power room and tied to the transformer secondary ground.

All metal throughout the building such as reinforcing steel, steel cabinets, panelboards, antenna switches, hardware, cable shields, etc. will be physically bonded together and connected to the grounding grid or peripheral ground wire or indicated on the drawings.

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ELECTRICAL DESIGN ANALYSIS

STATINTL

TRANSMITTER BUILDING

[redacted]

[redacted]

Project TRANSMITTER of 17

Feature TRANSMITTER BUILDING Designed Date

Item ELECTRICAL DESIGN ANALYSIS Checked Date

LOAD & SERVICE ANALYSIS

CONNECTED LOAD : 789,786 KVA

MAX. DEMAND LOAD : 789,786 (CONN. LOAD) X 0.93 (DEMAND FACTOR) = 735.2 KVA

BLDG. DEMAND LOAD : 735.2 (MAX. DEMAND LOAD) ÷ 1.1 (DIVERSITY FACTOR) = 668.4 KVA

SERVICE : 240 VOLTS, 3 PHASE, 3 WIRE, 60 CYCLES

SERVICE SIZES ARE DERIVED UNDER SERVICE SIZE ANALYSIS WHERE DISTANCE FROM THE TRANSFORMER STATION IS CONSIDERED IN CALCULATING SIZE.

[redacted] INC.

Project TRANSMITTE[redacted] of 17
Feature TRANSMITTER BUILDING Designed Date
Item ELECTRICAL DESIGN ANALYSIS Checked Date

L O A D S C H E D U L E

ITEM	LOAD DESCRIPTION	CONN. LOAD VA	DEMAND FACTOR	DEMAND LOAD-VA	USE * FACTOR	USE LOAD-VA
PANEL "A"	FLUORESCENT LIGHTS	4,600	1.00	4,600		
	INCANDESCENT LIGHTS	1,610	1.00	1,610		
	RECEPTACLES	3,780	0.50	1,890		
	REFRIGERATOR	510	1.00	510		
	EXHAUST FANS	360	1.00	360		
	RANGE	10,500	0.80	8,400		
	TOASTER	2,700	0.80	2,160		
	HOT WATER HEATER	2,000	1.00	2,000		
	SPARE	4,500	0.70	3,150		
	SUB-TOTAL	35,560	0.83	29,680		
PANEL "B"	FLUORESCENT LIGHTS	11,400	1.00	11,400		
	INCANDESCENT LIGHTS	200	1.00	200		
	RECEPTACLES	5,400	0.50	2700		
	SPARE	2,250	0.70	1,575		
	SUB-TOTAL	19,250	0.82	15,875		
PANEL "C"	INCANDESCENT LIGHTS	4,700	1.00	4,700		
	RECEPTACLES	2,160	0.50	1,080		
	ROOF VENT.	750	1.00	750		
	BATTERY CHARGERS	600	0.50	300		
	SPARE	3,000	0.70	2,100		
	SUB-TOTAL	11,210	0.80	8,930		
MOTOR CONTROL CENTER MCC"	AIR COOLED CONDENSERS	16,200	1.00	16,200		
	CHILLED WATER CIRC. PUMPS	11,400	1.00	11,400		
	AIR HANDLING UNITS	14820	1.00	14820		
	DUCT HEATER	6,000	0.0 **	0		
	WATER CHILLERS	112,236	1.00	112,236		
	VENT. SYSTEM	9660	1.0	9,660		
	SUB-TOTAL	170,316	0.96	164,316		

* DEMAND FACTOR DETERMINES FEEDER SIZES

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** HEATING EQUIP. DOES NOT RUN WHEN A/C UNIT ON.

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Feature TRANSMITTER BUILDING Designed _____ Date _____
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LOAD SCHEDULE

ITEM	LOAD DESCRIPTION	CONN LOAD VA	DEMAND FACTOR	DEMAND LOAD-VA
PANEL "D"	FLOOD LIGHTS	8400	1.0	8400
	GATE HOUSE	2000	1.0	2000
	OBSTRUCTION LIGHTS	1,700	1.0	1,700
	ANTENNA ROTATOR MOTORS	9,600	0.5	4800
	SPARE	1,500	0.8	1,200
		23,200	0.78	18100
PANEL "TA"	EQUIP.	20,000	1.0	20,000
PANEL "TB"	EQUIP.	8,000	1.0	8,000
SWGR. "MS"	PANEL "A"	35,560	0.83	29,680
	" "B"	19,250	0.82	15,875
	" "C"	11,210	0.80	8930
	" "D"	23,200	0.78	18,100
	" "TA"	20,000	1.0	20,000
	" "TB"	8,000	1.0	8,000
		117220	0.86	100585

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Project TRANSMIT[redacted]
Feature TRANSMITTER BUILDING — Designed _____ Date _____
Item ELECTRICAL DESIGN ANALYSIS — Checked _____ Date _____

L O A D S C H E D U L E

ITEM	LOAD DESCRIPTION	CONN. LOAD VA	DEMAND FACTOR	DEMAND LOAD-VA		
SWGR. "M"	TRANSMITTER RM. (109) NO.1	166,000	1.0	166,000		
	" " (110) NO.2	159,000	1.0	159,000		
	DRY TYPE TRANSF. 1-150 KVA	117220	0.86	100,585	(SWGR. "MS")	
	REMOTE RADIATOR	16800	1.0	16800		
	SPARE	160,000	0.8	128000		
	MOTOR CONTROL CENTER "MCC"	170,316	0.96	164,316		
		789,336	0.93	734701		
TOTAL BLDG. LOAD	SWGR. "M"	789,336	0.93	734701		
	CKT. BKR. FOR EXIT LIGHTS & FIRE ALARM SYSTEM	450	1.0	450		
		789786	0.93	735151		

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LOCATION	REQ'D & MTD. F.C.	ROOM SIZE W. X L.	AREA	CEILING & MTD. HEIGHT	ROOM INDEX	NO OF FIXT	COEF. OF UT. REFL.	COEF.	M.F.	REQ'D & MTD. LUMENS	NO. & SIZE OF LAMP LUM. OF FIXT.	TYPE OF FIXTURE
OFFICE 101	100 100	10.6 x 13.5	143.1	9'-3"	H	6	75 50	.43	.70	47000 47,700	3/40 WFL 7,950 lm	"S - 3"
LINK EQUIP-MENT ROOM 102	75 72	10.6 x 14	148.4	"	H	4	" "	.48	.70	33 000 31,800	3/40 WFL 7,950 lm	"F - 11"
MAINT. SHOP 103	75 83	10.6 x 25.9	274.5	"	G	8	" "	.51	.70	57,600 53,200	3/40 WFL 7,950 lm	"
CORRIDOR 104	20 17.0	3.2 x 52.0	169.3	8'-8"	J	8	" "	.22	.65	23,400 21,300	1-430 WFL 2,950 lm	"SPC-1"
DAY ROOM 105	33 46	10.6 x 10	106	9'-7½"	I	8	" "	.44	.70	18,000	3/40 WFL 7,950 lm	"F-11"
KITCHN 106	50 61.6	10.6 x 7.6	80.5	"	I	2	" "	.44	.70	12,600 7,950	3/40 WFL 7,950 lm	"
TOILET 107	15 16.5	10.2 x 2.0	20.4	"	I	2	" "	.30	.70	1,650 1,400	1-200 W 2,100 lm	"SC-3"
PARTS ROOM 108	50 63	10.6 x 25.3	268.2	"	G	6	" "	.51	.70	37,800 37,200	3/40 WFL 7,950 lm	"F-11"
TRANSMITTER RM. 109 110	75 95.4	24.4 x 54.3	1,324.9									
	23.0			8'-6"	D	16	75 50	.66	.70	215,000 34,800	2/40 WFL 5,800 lm	"F - 9"
	48			9'-0"	D	4	" "	.66	.70	42,400	4/40 WFL 10,600 lm	"NS-1"
	20.5			10'-6"	E	12	" "	.61	.70	63,000	2/40 WFL 5,300 lm	"F - 9"
	20.5			10'-6"	E	6	" "	.61	.70	33,600	4/40 WFL 10,500 lm	"NS-1"
CONTROL ROOM 111	75 165	24.1 x 24.1	610.1	12'-6½"	G	6	" "	.53	.70	33,600 35,400	4/40 WFL 10,500 lm 3/40 WFL 8,300 lm	"NS-1" "F - 9"
AIR COND. EQUIP. 112	75 15.6	24.1 x 25.5	620.9	12'-6"	G	8	50 30	.51	.65	39,600 33,500	1 - 750 W 13,100 lm	"I - 3"
POWER ROOM 113	75 14.1	24.1 x 43.5	1059.9	12'-6"	F	15	" "	.54	.65	59,400 56,500	1-200 W 3,100 lm	"

PROJECT TRANSMITTER BLDG.
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TRANSFORMER CAPACITY DETERMINATION

BUILDING SERVICE TRANSFORER:

PRIMARY 13.8KV 3φ3W 60CPS
SECONDARY 240V, 3φ3W

TOTAL CONNECTED LOAD = 789.8 KVA

TOTAL DEMAND LOAD = 735 KVA, DEMAND FACTOR = 0.93

MAXIMUM DEMAND LOAD ≒ 668 KVA, DIVERSITY FACTOR = 1.1

THEREFORE A 150KVA TRANSFORMER IS SELECTED

DRY TYPE INTERIOR DISTRIBUTION TRANSFORMER:

PRIMARY 240V, 3φ3W, 60CPS
SECONDARY 120/208V, 3φ4W

TOTAL CONNECTED LOAD = 117.2KVA

TOTAL DEMAND LOAD = 100.6 KVA DEMAND FACTOR = 0.86

MAXIMUM DEMAND LOAD = 100.6 KVA DIVERSITY FACTOR = 1.0

A 150 KVA TRANSFORMER IS SELECTED PER CRITERIA REFERENCE a.4.

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Project TRANSMITTER [redacted] of 17
Feature EXTERIOR UTILITY Designed M.I. Date 15 JAN. '68
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FLOODLIGHTING CALCULATIONS

CALCULATION FOR REQUIRED NUMBER & SIZE OF FLOODLIGHTS BASED ON "LUMENS IN THE BEAM" METHOD

$$\text{BEAM LUMENS REQUIRED} = \frac{\text{AREA IN SQ. FT.} \times \text{FT. C. REQD} \times \text{FACTOR FOR LIGHT FALLING OUTSIDE AREA}}{\text{MAINTENANCE FACTOR}}$$

BEAM LUMENS REQUIRED TABLE

AREA DESCRIPTION	AREA	FOOT CANDLE REQUIRED	LIGHT LOST FACTOR	MAINTENANCE FACTOR	AREA LUMENS REQUIRED	FLD. LGT. ANGLE REQUIRED
(285'x190')						
-(135'x26')-(55'x27')						
-(25'x27')-(33'x44') =	47028(SF)	1	1/0.75	0.75	83600	V: 73.5° H: No Limit
TOTAL						

(*) IES-NEMA TYPE

FLOODLIGHT DATA TABLE

DESCRIPTION	WATTS	BEAM	VERT. ANGLE TO 10%	HORIZ. ANGLE TO 10%	LAMP LUMENS	BEAM EFF.	BEAM LUMENS	NO OF FLOOD-LIGHTS	F.C. MTD.
47028 SF AREA	300	WIDE, TYPE 5(*)	91°	96°	5900	52.1%	3075	28	1.02
TOTAL									

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ELECTRICAL DESIGN ANALYSIS

GATE HOUSE

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Project TRANSMITTER [redacted] of 17

Feature GATE HOUSE Designed Date

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LOAD & SERVICE ANALYSIS

CONNECTED LOAD: 2.0 KVA

MAX. DEMAND LOAD: 2,000 (CONN. LOAD) X 1.0 (DEMAND FACTOR) = 2.0 KVA

BLDG. DEMAND LOAD: 2.0 (MAX. DEMAND LOAD) ÷ 1.0 (DIVERSITY FACTOR) = 2.0 KVA

SERVICE: 120/208 VOLTS, 1 PHASE, 3 WIRE, 60 CYCLES

SERVICE SIZES ARE DERIVED UNDER SERVICE SIZE ANALYSIS WHERE DISTANCE FROM THE TRANSFORMER STATION IS CONSIDERED IN CALCULATING SIZE.

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Feature GATE HOUSE Designed _____ Date _____
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L O A D S C H E D U L E

ITEM	LOAD DESCRIPTION	CONN LOAD VA	DEMAND FACTOR	DEMAND LOAD-VA
PANEL	LIGHTS	850	1.0	850
	RECEPT	150	1.0	150
	HEATER	1000	1.0	1000
		2000	1.0	2000

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Feature GATE HOUSE

Item ELECTRICAL DESIGN ANALYSIS

Designed _____ Date _____

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LIGHTING REQUIREMENTS

LOCATION	REQ'D. & MTD. F.C.	ROOM SIZE IN FT. W X L	ROOM SIZE IN FT. AREA	CEILING & MOUNTING HEIGHT	ROOM INDEX	COEF. OF UT. REFL.	COEF. OF UT. COEF.	M.F.	REQ'D. & MTD. LUMENS	NO. OF FIXT	NO. LAMPS & SIZE / FIXT. LUMS	FIXTURE TYPE
GATE HOUSE	10 / 12.8	5.5 x 5.5	30	8'-6"	J	.75	.10	.75	2100 / 2700	1	1-150W 2700lms	"LR"

TOTAL LUMENS = REQ'D F.C. X AREA / COEF. X M.F.

F.C. = TOTAL LUMENS X COEF. X M.F. / AREA

REQ'D LUMENS = REQ'D F.C. X AREA / COEF. X M.F.